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Quarterly Development Report

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DEVELOPMENT OF --

FILM DIELECTRIC CAPACITORS ---- HIGH TEMPERATURE

This report covers the period April 1, 1954 to July 1, 1954

TOBE DEUTSCHMANN CORPORATION

921 Providence Highway Norwood, Massachusetts

NAVY DEPARTMENT BUREAU OF SHIPS ---- ELECTRONICS DIVISION

FURTHER DISSEMINATION IS AUTHORIZED ONLY TO MILITARY AGENCIES.

Contract No. NObsr-57200

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Index No. NE-111016, St. 1.

Date of Contract: Feb. 20, 1952

Date of Repo t: July 15, 1954

CMP Classification: Class "A" Product

Certification DO-A-7; certified under CMP Regulation #3

OCT 27 1954

54AA 66286

ABSTRACT

PHASE I.

The leakage current of Foil Type Mylar Capacitors at 150° C. Life Test conditions, is considerably higher than was anticipated by the use of Dielectric Resistance vs. Temperature curves, previously obtained. This abnormally high current drain overloaded the power supplies which were installed for these tests. This high current also precluded the use of the automatic timing and clearing mechanism. By using heavy-duty voltage supplies and substituting manual control for automatic relay circuits, we were able to Life Test the six groups of capacitors reported on, in this document. The results with such a small total of test units is, of course, not conclusive, but the indications substantiate our past theory that our present Mylar C does not effectively operate at temperatures as high as 150

PHASE II.

The greatest problem with Metallized Mylar C Capacitors to date was the high number of opens that occurred during Life Tests. All work done with such units during this quarter was devoted to solving this difficulty. The ensuing

ABSTRACT (continued)

data in this report reveals that our efforts have not corrected
the situation one hundred percent, but the comparative few opens
that mw occur are sufficient to make our test data significant.

PART I.

PURPOSE

A. Develop Film Dielectric Capacitors, high temperature, utilizing DuPont "Mylar" film (V-200) or equivalent, as a capacitor dielectric, in order to achieve higher temperature operation and greater reliability of fixed paper capacitors, in accordance with Bureau of Ships Contract Specification SHIPS F-400, dated 15 September, 1951, as follows:

B. Phase I.

1. Evaluate a V-200 film or equivalent in accordance with paragraph 3.2.1 of referenced Bureau of Ships Contract Specification SHIPS F-499.

- Furnish fifty (50) each of various capacitors as described in paragraph 3.2.1 of referenced Bureau of Ships Contract Specification SHIPS F-499.
- 3. Submit reports as specified therein.

C. Phase II

- Evaluate a V-200 or equivalent with metallized electrodes
 in accordance with paragraph 3. 2. 2. of referenced Bureau
 of Ships Contract Specification SHIPS F-499.
- Furnish fifty (50) each of various capacitors as described in paragraph 3.2.1 of referenced Bureau of Ships Contract Specification SHIPS F-499.
- Furnish one (1) set of Type D Class IV Manufacturing
 Drawings in accordance with Bureau of Ships Specification 16D19 (RE), dated 15 January 1946, and Amendment No. 2, dated 1 May 1948.
- 4. Submit Reports as spe cified herein.

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Life Tests were conducted at 125° C. and at stresses of 200, 300, 400, 500, 600 and 700 volts per mil. The 500 volts per mil stress produced a failure of 8% failures in 72 hours; the 600 volts per mil stress, 56% loss in 72 hours. Accordingly, the 30% point presumably will occur within these two values.

It was observed during this quarter that as a result of using manual controls on our Life Tests, thereby extending the exposure time to high temperature without voltage, that the failures occurring late in the Life Test (close to the 72-hour minimum) were more difficult to examine than those of shorter duration. In most cases, the outside half or two-thirds of the section would readily unwind, but the inner portion had become very brittle. In many instances, the Mylar would shatter into tiny fragments as the unit was being unwound.

The actual points of failure differ in physical appearance, also. All previous failures have caused ruptures in the Mylar, both inwardly and outwardly from the exact breakdown. The number of layers on either side of the failure, vary between 3 and 12. All failures that were found in the embrittled Mylar C never penetrated more than two layers.

A gradual decrease in leakage current occurred during Life Test

GENERAL FACTUAL DATA Phase I (continued)

indicating an effective increase in insulation resistance. This phenomenon seemed to occur to an equal degree without the application of voltage. This may indicate the possible requirement of long-term ageing to develop required characteristics.

PHASE II

During the last period, experiments were conducted to evaluate two methods of reducing opens during Life Test on Metallized Mylar Capacitors. The first method was to increase the margin of the capacitor and to melt down the excessive margin during the spraying operation. The hot copper spray melts back a sufficient amount of Mylar so that the use of the wider margin does not result in a larger capacitor.

This method has proven to be generally successful as indicated in the attached data.

The second method has been to fold the edge of the Mylar during the winding operation, thereby presenting a metal surface to the copper spray rather than the edge of a Mylar film. This method resulted in an excessive number of voltage breakdowns during the application of initial voltage tests.

The remaining capacitors went through Life Test satisfactorily without opens.

GENERAL FACTUAL DATA Phase II (continued)

The unusual amount of voltage breakdowns during initial voltage tests were traced to a cracking of the Mylar during the folding operation.

As this operation is difficult and did not produce a good yield, it was abandoned in favor of the first-mentioned mathod.

DETAIL FACTUAL DATA

PHASE I

All tests made in Phase I during the last quarter were conducted at 150°C. The capacitors used at this time were of similar design to those used previously -- namely 1 Mfd. constructed with two layers of .0005" Mylar C film between foils. The test units were constructed with Mylar C taken from the same lots that were used for the test units made previously. The gauge from roll to roll and within each roll varied between limits of .00048" and .0006".

- A. Seventy-five units were divided into three groups of twenty-five each:
 - 1. Tested at 200 VDC, all units passed rests prior to Life Test. Twenty-five units were placed on Life Test, and all twenty-five completed 72 hours. (See Part III. P.1)
 - Tested at 300 VDC, all units passed tests prior to Life Test. Twenty-five units were placed on Life
 Test and all twenty-five completed 72 hours. (See

T

DETAIL FACTUAL DATA - Phase I (continued)

Part III, P. 2.)

- 3. Tested at 400 VDC, all units passed tests prior to

 Life Test. Twenty-five units were placed on test,

 and twenty-three completed 72 hours. Both failures

 were caused by Mylar faults. (See Part III, P. 3.)
- B. Seventy-five units were divided into three groups of twenty-five each.
 - 1. Tested at 500 VDC, all units passed tests prior to Life
 Test. Twenty-five units were placed on test and
 twenty-three completed 72 hours. Both failures were
 caused by Mylar faults. One unit opened during the
 test. (See Part III, P. 4.)
 - 2. Tested at 600 VDC, all units passed tests prior to Life Test. Twenty-five units were placed on Life Test, and eleven completed 76 hours. There were thirteen Mylar failures, 1 mechanical failure and 1 unit opened during the test. (See Part III, P. 5.)
 - 3. Tested at 700 VDC, all units passed tests prior to
 Life Test. Twenty-five units were placed on Life
 Test, and sixteen completed 72 hours. All nine
 failures were caused by Mylar faults. (See Part
 III, P. 6.)

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All tests performed this quarter were at 125° C. and the test unit was the .25 Mfd. Capacitor, constructed with a single layer of .0005" Metallized Mylar C. The material used was slit and margined by the TOBE DEUTSCHMANN CORP. from 2" rolls, slit to 1" rolls with 3/32" margins.

- A. Seventy-five units were divided into three groups of twenty-five each:
 - Tested at 600 VDC, all units passed tests prior
 to Life Test. Twenty-five units were placed on
 Life Test, and fifteen completed 250 hours.
 There were ten failures caused by Mylar faults.
 Two units opened during the test. (See Part III,
 P. 7.)
 - 2. Tested at 700 VDC, two units failed during prebreakdown voltage test. Both were caused by Mylar faults. The remaining twenty-three were placed on Life Test, and six completed 250 hours. There were seventeen failures caused by Mylar faults. Two units opened during the test. (See Part III, P. 10).
 - 3. Tested at 800 VDC, five units failed tests prior to Life Test. One unit opened during the initial voltage test, and four units failed during the prebreakdown voltage test. The remaining twenty units were placed on Life Test, and eight completed 250 hours.

There were twelvefailures caused by Mylar faults.
(See Part III, P. 13)

- B. Seventy-five units were divided into three groups of twentyfive each:
 - 1. Tested at 400 VDC, two units failed tests prior to

 Life Test. One unit opened and the other failed the
 initial voltage test. The remaining twenty-three
 units were placed on Life Test, and all twenty-three
 completed 251 hours. (See Part III, P. 16).
 - 2. Tested at 500 VDC, one unit failed the initial voltage test. The remaining twenty-four units were placed on Life Test, and twenty-two completed 251 hours. Both failures were caused by Mylar faults. (See Part III, P. 19)
 - 3. Tested at 600 VDC, one unit failed during the prebreakdown voltage test. The remaining twenty-four unitswere placed on Life Test and sixteen completed 258 hours. Eight units failed because of Mylar faults. (Sec Part III, P. 22)
- C. Sixty units were divided into three groups of twenty each:
 - 1. Tested at 400 VDC, nine units failed tests prior to

 Life test. Eight units failed the initial voltage test

 and one failed during the pre-breakdown voltage

 test. The remaining eleven units were placed on

 Life Test, and all eleven completed 251 hours.

 (See Part III, P. 25)

DETAIL FACTUAL DATA -- Phase II (continued)

C. (continued)

- 2. Tested at 500 VDC, six units failed the initial voltage test prior to Life Test. The remaining fourteen units were placed on Life Test and all fourteen completed 251 hours. (See Part III, P. 28.)
- 3. Tested at 600 VDC, one unit failed during prebreakdown voltage test. The remaining nineteen
 units were placed on Life Test, and sixteen
 completed 251 hours. The three failures were
 caused by Mylar faults. Three units opened
 during the test. (See Part III, P. 31)

Table

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C CAPACITORS . 5 Mil METALLIZED MYLAR .25 MFD. SINGLE

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441 141 Page TABLE I

(continued)

SINGLE . 5 MIL . 25 MFD.

METALLIZED MYLAR C CAPACITORS

Margine	1/16"	1/16"	1/16"	1/16"	1/16"	1/16:1	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"
Number Temporary Opens		488	1690	862	83	153	104	161	342	313	416	1028	1233	100
Number Opened	6	7	12	12	m	7	2	7	9	7	10	14	15	0
Number Finished	11	18	9	7	22	21	23	17	13	11	10	-	7	19
Number Failed	0	0	m	0	0	0	0	0	 1		0	m	m	0
Number Started	50	20	21	19	25	23	25	19	19	19	20	18	20	19
> 1	800													800
Temp.	85° C.	85° C.	85° C.	85°C.	85° C.	85° C.	85°C.	85°C.	85° C.	85° C.	85° C.	85° C.	85°C.	85°C.
NObsr	22	23	24	25	92	27	82	53	30	31	32	33	34	35

Page 12.

13. Page

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TABLE 1 (continued)	SINGLE .5 MIL	MAT	
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Margins		1/16"	1/10n
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Number Opened		m	œ
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Number Started		21	23
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Temp.		85° C.	85° C.
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	1/16"	1/16"	1/16"	1/16"	1/16"	1/16"
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11	16	15	ιΩ	18	12	2
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	22	25	22	23	21	21
	400	200	009	300	400	200
	125° C.					
	38	39	40	41	42	43

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TABLE II (continued)

. 25 MFD. SINGLE . 5 MIL

METALLIZED MYLAR C CAPACITORS

VObsr	Temp.		Number Started Test	Number Failed	Number Finished	Number Opened	Number Temporary Opens	Margins	
44	125° C.	300	25	0	25	0	14	3/32"	£
45	125° C.		25	Ç	25	0	186	3/32"	
46	125° C.		57	•	54	0	171	3/32"	
47	125° C.		25	10	ध	8	521	3/3211	
48	125° C.		23	17	•	72	929	3/32"	
49	125° C.		20	12	∞	0	1350	3/32"	
20	125° C.		23	0	23	0	œ	3/32"	
ជ	125° C.		5 4	7	22	7	39	3/324	
52	125° C.		24	®	16	0	249	3/32"	
53	125° C.	400	Ħ	•	Ħ	•	N	3/32"	1/32 roll-
54	125° C.	200	14	0	14	0	59	3/32"	*
55	125° C.	009	19	ĸ	16	m	237	3/32"	os Li

Page 14.

CONCLUSIONS

PHASE I

The number of units tested at 150° C. is too small to yield conclusive results. Indications are that a 1 Mfd. Capacitor with two layers of .5 Mil Mylar C between foils will operate at this temperature for 1000 hours at 300 volts per mil, and 8000 hours at 200 volts per mil.

Capacitors operated at these rather low stresses are extremely bulky and their application probably will be limited by their size.

Obviously, this Mylar C does not yet provide an answer for miniaturization at this temperature.

PHASE II

By reviewing the Tables found on pages 11, 12, 13 and 14, it is very evident that by changing our design to a slightly greater protective margin, we have practically eliminated the problem of opens occurring during Life Test. Before the change was made, the column headed "Number Opened" was heavy, and the column headed "Number Failed" was light. Now the

CONCLUSIONS (continued)

PHASE II

situation is completely reversed, which is what it should be since it is the purpose of this project to evaluate the units of Mylar C as a dielectric.

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PART II.

PART II.

PROGRAM FOR NEXT INTERVAL

PHASE I.

We have received from E. I. duPont de Nemours & Co., Inc. a very small trial lot of the new Mylar C which has been wound into capacitors and are now starting Life Test. Upon the performance of these units rests the decision whether additional work be done with plain Mylar C or whether this phase of the project be postponed until the manufacturer of the film can provide us with better and more consistent material.

PHASE II.

Now that the problem of "opens" occurring during Life Test has been corrected, it is our intention to review the entire Life Test program conducted with . 25 Mfd. units constructed with a single .5 Mil of Metallized Mylar C. All tests, whether they be at 35° C. or 125° C. that resulted in excessive opens, will be run again with new units of similar construction, but with $3/32^{\circ}$ margins.

III. PART

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NObsr M #47

437

Twenty-five .25 Mfd. single half Mil Metallized Mylar C Units.

161 hours

The units (25) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C. Next, the units were exposed to 600 v.d.c. pre-breakdown test for one-half hour. During this period, there were 129 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time
0	6.4 Mfd.	Start of test
·		Unit #7 failed after .5 hours; 109 temporary breakdowns.
		Unit #5 failed after one hour; 249 temporary breakdowns.
283	5.25 Mid.	23 hours
308	5,25	45 18
334	4.85	115
		Unit #18 failed after 334 temporary breakdowns.
	•	Unit #23 failed after 121 hours and 358 temporary breakdowns.
394	4.25	144 hours
		Unit #6 failed after 394 temporary breakdowns.
		Unit #19 failed after 146 hours and 405 temporary breakdowns.
414	4.00	151 hours

4.15

NObsr M #47 (continued)

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Temporary Breakdowns	Total Capacitance	Elapsed Time
		Unit #9 failed after 448 temporary breakdowns.
461	3.75 Mfd.	179 hours
		Unit #12 failed after 181 hours
		and 469 temporary breakdowns. Unit #17 failed after 199 hours and 478 temporary breakdowns.
481	3.10 "	1 99 hours
501	2.60 "	222 ***
		Unit #24 failed after 222 hours and 501 temporary breakdowns.
521	2.68	250 hours
		Test completed
Number of units started on te	est	· · · · · · · · · · · · · · · · · · ·
Number finished	• • • • • • • • • • • • • • • • • • •	15
Total capacitance before Life	e Test = room tempe	erature 5.80 Mfd.
H H H H - H	" at 125° C	6.75 Mfd.
" after pre-break	kdown test	6.40 Mfd.
" " after Life Test		2.68 Mfd.
Number of permanent failure	5	10
Number of temporary failure	5	
Number of opens at the end of	f the test	· · · · · · · · · · · · · · · · · · ·

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NObsr M #48

Twenty-five .25 Mfd. single half Mil Metallized Mylar C units.

The units (25) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C. Next, the units were exposed to 700 v.d.c. pre-breakdown test for one-half hour. During this period, there were 154 temporary breakdowns. Unit #19 failed after 45 temporary breakdowns, and unit #12 after 141 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Breakdowns	Total Capacitance	Elapsed Time
0	5.80 Mfd.	Start of test

Unit #14 failed immediately after 83 temporary breakdowns: #16 after one hour - 167 breakdowns. #11 failed after one hour with 212 temporary breakdowns. Unit #15 failed after one hour having 250 temporary breakdowns. #13 failed after one hour - 252 temporary breakdowns. Unit #9 failed after one hour; this unit had 313 temporary breakdowns. Unit #5 failed after two hours - 324 temporary breakdowns. Unit #7 failed after three hours, and had 336 temporary breakdowns. Unit #25 failed after 21 hours - 346 temporary breakdowns.

346

3.10 Mfd.

21 hours

Unit #18 failed after 22 hours; this unit had 353 temporary breakdowns. Unit #6 failed after 24 hours - 368 temporary breakdowns. Unit #2 failed after 25 hours and had 373 temporary breakdowns.

NObsr M #48 (continued)

	Tempora Breakdov		. 0	Total apacitance	e	Elapsed Time	±4
	405			2.20 Mf	đ.	96 ho	urs.
					£a	ailed after	led. Unit #21 98 hours - cary breakdown:
					9	Init #23 fa 9 hours – reakdowns	443 temporary
	524			1.55 Mf	d.	125 h	ours
	582			1,20 "		148 h	ours
					J	Juit #3 fai	led.
	590			。90	1	211 hou Unit #17 fa	
	594			1.00		230 ho	urs
	620			.40		250 ho	urs
						Test Con	pleted.
Num	ber of units	started on	test		5 v 9 e 9 e a c 1		23
Num	ber finished		90000000		0 0 0 0 0 0 0 0	0 0 0 0 0 0	6
Total	l Capacitano	ce before I	ife Test -	room tem	p	• 0 0 0 0 0 0 0	5.80 Mfd.
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11	11	after pr	e-breakdo	wa test	0 . 0 0 0 0 0 0	>	5.80 Mfd.
11	11	" Li	te Test	0 0 0 0 0 0 0 0 0		. , , , , , , , , , ,	40 Mfd.
Num	ber of perm	anent failu	res	000000000	00000000	000000	17
Num	ber of temp	orary failu	res			6	20
	ber of open						2

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8 ON TEST 1	FOR WENTAL	V. WINROTH CONTRACT NO. 110 hst 5720	-
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19 Number 1 2 3 1 5 6 7 6 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 19 2	tarted Clock # \$ 65.62 Date	May 54 Tray # 3 38/2 Total Hours 25	
16 Number 1 2 3 4 5 6 7 6 9 10 11 12 13 14 15 16 7 1 18 19 20 12 12 12 12 12 12 12 12 12 12 12 12 12	THE DIRECTRI	AL TESTS BEFORE LIFE TEST	
TEST 1	9 2 1 2 2 1 2 6 2	11 12 13 14 15 16 17 18 19 20 21 22 23	<u>2</u>
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Twenty-five .25 Mfd. single half-Mil Metallized Mylar C units.

The units (24) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C. for one-half hour. The capacitance was then measured at 125° C. Next, the units were exposed to 800 v.d.c. pre-breakdown test for one-half hour. During this period, there were 661 temporary breakdowns. Units #22, #20, #16, #23 failed after 64, 106, 415, and 661 temporary breakdowns respectively. The capacitance was then once again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time
0	4.80 Mfd.	Start of Test
	·	Unit #9 failed after one hour - 533 temporary breakdowns. Unit #17 failed after 2 hours - 58 temporary breakdowns.
		Unit #18 failed after two hours - 687 temporary breakdowns. Unit #25 failed after four hours - 768 temporary breakdown

2.55 Mfd.

21 hours

breakdowns.

Unit #12 failed after 21 hours - 855 temporary

Unit #24 failed after 22 hours - 900 temporary breakdowns. Unit #1 failed after 24 hours -912 temporary breakdow

Unit #21 failed after 25 hours - 928 tempora breakdowns. Unit #13 failed after 95 hours -1039 temporary breakdowns

855

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NObsr M #49 (continued)

Temporary Breakdowns	Total Capacitance	Elapsed Time
1039	1.43 Mfd.	95 hours
		Unit #5 failed after 118 hours - 1132 temporary breakdowns. Unit #3 failed after 119 hours - 1179 temporary breakdown
1179	.98 Mfd.	120 hours
1237	.98 Mfd.	145 hours
1321	. 65 Mfd.	209 hours
		Unit #6 failed.
1333	.88 Mfd.	227 hours
1350	.75 Mfd.	250 hours
		Test Completed

Number	of units	started o	n test	• 0 0	• • • • •		20	
Number	finished	00000000			00000		8	
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Twenty-five .25 Mfd.
single half-Mil
Metallized Mylar C
Units

The units (23) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C, for one-half hour. The capacitance was then measured at 125° C. Next, the units were exposed to 400 v.d.c. pre-breakdown test for one-half hour. During this period, there were 114 temporary breakdowns. The capacitance was measured again before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time
0	6.00 Mfd.	Start of Test
1	6.00 "	30 hours
1	5.95 "	57 "
1	6.00 ".	76 ''
1	6.00 "	106 "
6	6.00 "	169 "
6	6.00 "	196 ''
8	6.00 "	222 "
8	6.00 "	251 "

Test Completed

NObsr M #50 (continued)

Numbe	r of units	started	on tes	st	• • • • • •	• • • •	• • • •	23			
Numbe	r finished	i		• • • •	•••••			23			
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11	19	11	Life	Test					o o •	6.00	Mfd.
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Numbe	r of temp	orary fa	ilures	• • • •	• • • • • •	• • • •	• • • •	8			
Numbe	r of open	s at the	end of	the t	est			0			

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Twenty-five .25 Mfd. single half-Mil Metallized Mylar C Units

The units (24) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C. for one-half hour. After this, the capacitance was measured at 125° C. Next, the units were exposed to 500 V.D.C. pre-breakdown test for one-half hour. During this period, there were 57 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time
0	6.00 Mfd.	Start of Test
14	5.80 "	19 hours
15	5 . 90 ii	45 "
17	5.95 "	65 "
24	6.00 "	95 "
27	5.80 "	138 "
28	5.80 "	185 "
33	5.60 "	209 "
		Unit #10 failed after 202 hours - 33 temporary breakdowns.
36	5.70	253 Hars
		Unit #23 failed after 248 hours - 39 temporary breakdowns.
30	5.40 !!	231 hours

231 hours

39

5.40 ''

Test Completed

NObsr M #51 (continued)

Numbe	r of uni	ts started	on test	• • • • • • •	24		
Numbe	r of uni	ts finished	• 0 0 0 0	• • • • • • • •	22		
Total o	apacita	nce before	Life Te	st - room	temperat	ture 5.8	0 Mfd.
11	**	11	9t 11	at 125°	c	6.9	0 Mfd.
**	**	after pre	-brea k d	own test	• • • • • • •	6.0	0 Mfd.
11	**	" Li	fe Test	• • • • • • • •		5.4	o Mfd.
Numbe	r of per	manent fai	lures		2		
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Twenty-five .25 Mfd.
single half-Mil Metallized
Mylar C Units.

The units (25) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125 °C. for one-half hour. The capacitance was measured at 125 °C; and the units were then exposed to 600 V.D.C. pre-breakdown test for one-half hour. During this period, there were 477 temporary breakdowns. Unit #19 failed after 444 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time
0	5.70 Mfd.	Start of Test
49	5.50 "	19 hours
52	5 . 60 "	45 "
69	5.50 "	65 "
		Unit #13 failed after 70 hours; there were 91 temporary break- downs. #6 failed after 87 hours; 129 temporary breakdowns.
129	5.10 Mfd.	87 hours
133	4.70 Mfd.	147 "

Unit #3 failed. #18 failed after 151 hours. There were 150 temporary breakdowns.

Unit #2 failed after 167 hours; 206 temporary breakdowns.

NObsr M #52 (continued)

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Temporary Breakdows	Total Capacitance	Elapsed Time
206	4,20 Mfd.	167 hours
		Unit #9 failed after 184 hours; 210 tem- porary breakdowns.
		#7 failed after 188 hours; there were 216 temporary breakdowns.
221	3.70 Mfd.	190 hours
233	3.60 Mfd.	214 "
239	3,50 Mfd,	237 "
		Unit #21 failed after 258 hours - 249 tem- porary breakdowns.
249	3,20 Mfd.	258 hours
		Test Completed
Number of units started on	test	, 25
Number finished	0 • 0 7 0 0 7 0 0 7 0 0 0 0 0 0 0 0 0 0	. 16
Total capacitance before Li	ife Test - room temp	5.55 Mfd,
11 11 11	' ' at 125 C	6,35 Mfd.
Total capacitance after pr	re-breakdown test	5,70 Mfd.
n n n n 15 <u>T</u> .	ife Test	3, 20 Mfd,
Number of permanent failu	Tes	8
Number of temporary failu	ires	249

Number of opens at the end of the test 0

Twenty, 25 Mfd, single
.5 Mil Metallized Mylar C
Units.

The units (12) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C. for one-half hour. The capacitance was then measured at 125° C. After that, the units were exposed to 400 V. D. C. pre-breakdown test for one-half hour. During this period, there were 161 temporary breakdowns. Unit #18 failed after 157 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time
0	3.00 Mfd.	Start of Test
2	2, 70 "	19 hours
2	2.65 "	45 "
2	2.65	65 "
2	2.85 "	95 ''
2	2。50 "	158 "
2	2.80 "	185 "
2	2. 80 "	211 "
2	2.60 "	234 "
2	2, 55 "	251 "
		_

Test Completed

NObsr M #53 (continued)

Numbe	er of unita	s started	on tes	it	• • • • • •	• • • • •		. 11		
Numbe	r finishe	d	• • • • •	• • • • •	, , , , , , , , , , , , , , , , , , ,			11		
Total	capacitan	ce before	Life	Test -	room	tempe	rature		2.90	Mfd.
11	11	tt	11	Ħ	at 125	°C,			3, 30	Mfd.
11	ti	after	presb	reakd	own tes	t			3.00	Mfd.
11	13	11	Life '	rest ,	000000				2, 55	Mfd,
Numbe	er of pern	nanent fai	ilures		,,,,,,,			0		
Numbe	er of tem	porary fa	ilures				0 3 0 3 0 0 0	2		
Numbe	r of open	s at the e	nd of	the te	st	0 0 0 5 6		0		

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Twenty . 25 Mfd. single . 5 Mil Metallized Mylar C Units

The units (14) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature. Then they were heated in an oven to 125° C. for one-half hour. The capacitance was then measured at 125° C. Next, the units were exposed to 500 V.D.C. pre-breakdown test for one-half hour. During this period, there were 48 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time		
0	3.80 Mfd.	Start of Test		
44	3, 80 "	19 hours		
46	3.60 "	46 "		
48	3,65 "	66 "		
52	3, 10 "	96 "		
54	3,60 "	158 "		
57	3,60 "	185 "		
57	3,60 "	21]. "		
59	3.60 "	235 "		
59	3.60	251 "		

Test completed

NObsr M #54 (continued)

Numb	er of unit	ts started o	ntest cocceeped acces 14	ł
Numb	er finish	ed		!
	-		Life Test - room temp	
*1	11	11	" at 125° C	3,90 Mfd,
11	11	after pr	e-breakdown test	3.80 Mfd.
11	11	" Li	fe Test	3.60 Mfd.
Numb	er of per	manent fail	ures0	
Numb	er of tem	porary fail	ures 59	
Numb	er of ope	ns at the er	d of the test	

Twenty .25 Mfd. single .5 Mil Metallized Mylar C units.

The units (20) were wired to a Life Test rack after the initial tests were concluded, and the total capacitance measured at room temperature.

Then they were heated in an oven to 125° C. for one-half hour. The capacitance was then measured at 125° C. After that, the units were exposed to 600 v.d.c. pre-breakdown test for one-half hour. During this period, there were 265 temporary breakdowns. Unit #12 failed after 10 temporary breakdowns. The capacitance was again measured before the Life Test commenced.

Temporary Breakdowns	Total Capacitance	Elapsed Time		
0	5.10 Mfd.	Start of Test		
		Unit #17 failed after 3 hours 123 temporary breakdowns.		
		#8 failed after 3 hours; 137 temporary break- downs.		
145	4.30 Mfd.	30 hours		
184	4.35 "	57 "		
184	4.35	77 "		
2.04	4.10 "	106 "		
		Unit #6 failed.		
225	4.00 Mfd.	169 hours		
227	4.05 Mfd.	196 "		
2 31	4,00 Mfd.	221 "		

NObsr M#55 (continued)

	Temporar Breakdow		Tota Capacit		Elap	sed ime	
	237		4.05	Mfd.	251	hours	
					Test o	ompleted.	
		~ ~ ~		• • • • •			-
Numb	er of units s	tarted	on test		c 0 0 2 2 c 2 c	19	
Numb	er finished.					16	
Total	capacitance	before	Life Test	- room tem	peratur	e	4,75 Mfd.
**	11	***	** **	at 125°	J,	u 5 4 0 # 4 0 0 n	5.20 Mfd.
**	17	after	pre-breakd	own test			5.10 Mfd.
11	11	**	Life Test .				4,05 Mfd.
Numb	er of perma	nent fai	ilures	2 n 2 n 0 0 0 0 0 0	0000000	3	
Numb	er of tempor	rary fai	ilures	(O 3 L @ 2 O O 4 D		237	
Numb	er of opens	at the e	end of the te	st	• • • • • • •	3	